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ABSTRACT

This master's thesis reports the results of a survey submitted to over 30 colleges and universities that currently offer computer graphics courses or are in the planning stage of curriculum design. Intended to provide a profile of the computer graphics programs and insight into the process of curriculum design, the survey gathered data on program philosophy, program history, curriculum and program structure, faculty and staff, admission standards, and systems and hardware. U.S. schools for which data are reported include the New York School of Visual Arts, the School of the Art Institute of Chicago, Syracuse University, Carnegie-Mellon University, the University of Missouri-Columbia, and the University of Oregon. Information is also presented on the graphics situation in seven schools of art and design in England and in New Zealand technical institutions. The interdisciplinary nature of computer graphics is then described, together with the formation of computer centers at the Illinois Institute of Technology, the Massachusetts Institute of Technology, Carnegie-Mellon University, and Ohio State University to research applications of new technology in all fields. A summary of the survey findings, including notes on the computer graphics situation in Canada and in Australia, conclude the report. A 23-item reference list is provided, and the survey instrument and a list of universities contacted are appended. (MES)

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CURRICULUM DESIGN OF COMPUTER GRAPHICS PROGRAMS

A SURVEY OF ART/DESIGN PROGRAMS AT THE UNIVERSITY LEVEL

A Thesis

Presented in Partial Fulfillment of the Requirements
for the Degree Master of Arts in the
Graduate School of the Ohio State University

by

Richard Lee Mckee

The Ohio State University
Autumn, 1986

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THESIS ABSTRACT

THE OHIO STATE UNIVERSITY

GRADUATE SCHOOL

NAME: Richard Lee Mckee QUARTER/YEAR: Autumn 1986

DEPARTMENT: Art Education DEGREE: Masters of Arts

TITLE OF THESIS:
Curriculum Design of Computer Graphics Programs A Survey of Art/Design Programs at the University Level

This thesis examines how several universities and colleges have introduced computer graphics and how each has responded differently to the implementation of computer graphics into their programs. Much of the data for this thesis was gathered from a survey submitted to over thirty colleges and universities which currently offer computer graphics courses, or which are into the planning stage of curriculum design. The survey was designed to provide a profile of computer graphics programs and to yield insight into the process of curriculum design.

_____
Adviser's Signature

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VITA

July 7, 1953	Born - Youngstown, Ohio
1978	B.F.A. Photography and Cinema, Ohio State University
1980	M.A. Photography and Cinema, Ohio State University
1980-1984	Multi-Image Producer, Photographer, Animator, The Media Group, Columbus, Ohio
1984-1986	Computer Animator, Cranston Csuri Productions, Columbus, Ohio

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CHAPTER 1

Introduction

Technology and the Computer Revolution

In the last two decades, a revolution in information processing and technology has emerged creating an impact on the way human beings communicate. Margaret Mead stressing the importance of communication states,

> The children of a culture take up the tools of a culture and the first tools are the tools of communication [18].

This communication revolution has stemmed almost entirely from the introduction of computers. Today computers are commonplace in industry, homes, and more importantly in education. The task of keeping pace with technological change has fallen on the educational system. White confirms this belief stating,

> The American education system will need to redirect its efforts to emerging social and technological realities if it is to fulfill its charge of adequately educating members of our society [22].

In 1980, the call for computer literacy was firmly established during a meeting of the Elementary and Secondary Schools Subcommittee of the Association of Computing Machinery (ACM). The following recommendations were made:

1. All students should be provided with instruction about the role of computers and communications in modern life and their affects on society.

2. All students should be taught about the power, usefulness, and limitations of computers and communication devices.

> 3. All students should have access to computer and communications systems for the creation, storage, and modification of information to be shared with others, including the teacher [15].

Once the question of computer literacy was established, a second area of concern surfaced, that of visual literacy. Mark Slade in his book The Language of Change writes,

> If the child of the future is to be literate in the contemporary world, he/she will have to learn two new language systems, 1. Data in motion, the language of the computer, and 2. Images in motion, the language of photographs, films, audio, video, and satellite communication systems [16].

The applications of computer technology as a visual tool are seemingly endless. Examples can easily be seen in the entertainment fields such as film, television, and videogames, as well as in scientific, medical and engineering fields. Computer images have become the norm in the graphics world, with Computer Aided Design systems, typography, interior and product design. Computer Graphics are providing new directions in architecture, music, and the fine arts. It has become quite evident that a new set of visual skills and even a new visual language has developed.

Although evidence of the computer in the fields of art and graphics is common, the growth and direction of new technology in the arts has been slow and somewhat cautious. As Clements explains, some artists and art educators have actually expressed fear and resentment.

> Some of us view the computer as one more manifestation of a dehumanized, impersonal world, the antithesis of arts potential for individual self expression [6].

The majority of artists and art educators are much more optimistic about computers in the arts and emphasize that the artist should interact with technology the way he always has. Madeja points out that technology is not a new phenomenon to the arts nor are the arts a new phenomenon to technology. There tends to be a belief that technology has contributed to the artistic process and subject matter.

> The artists' intent is to be innovative, unique, original, and the technology promotes a means to those ends. So not only does the artist use technology because it exists, but he uses it because it gives him a tool or device to enhance the aesthetic qualities of their own artistic expression [17].

This thesis examines how several top universities and colleges have introduced computer graphics and how each has responded differently in the implementation of computer graphics into their programs. The data for this thesis was gathered from a survey submitted to over thirty colleges and universities which currently offer computer graphics courses, or are in the planning stage of curriculum design. The survey was designed to provide a profile of the computer graphics programs and to provide some insight into process of curriculum design. The survey included the following areas of research :

1. Program philosophy.
2. Program history.
3. Curriculum and program structure.
4. Faculty and Staff.
5. Admission Standards.
6. Systems and hardware.

The complete survey can be found in Appendix A.

Rationale

There are many reasons why the new technology and specifically computers should be introduced into the realm of art and design education.

1. Computers in the arts provide the equivalent of computer literacy to the artist, in other words visual computer literacy.

2. Computers will provide basis for new direction and application in the arts.

3. Computers will provide new methods of education and training so that designers and artists can meet the needs

of the nation's social and industrial well being.

4. The computer is a tool which can be used in the arts. It adds a new dimension in terms of visual choice, manipulation and versatility.

5. Computers can provide the integration of art and other areas such as computer science, which were formerly separate. This integration of formerly separate disciplines creates a need for new combinations of knowledge, skill, and experience.

6. Computer images have implications for the artistic process itself and that of the future.

7. Technology provides the opportunity to accelerate and enhance visual information and will therefore change the way artists and designers create.

8. Computers will stimulate visual research and develop techniques to use in this new media.

9. Computers will provide input into the evolution of computers to improve not only the way they look or are programmed, but how they relate to the users in the arts.

Objectives for a Computer Graphics Curriculum

Attempting to define some general goals or objectives for computers in an art or design curriculum is very difficult.

> There is no single direction in computer graphics because of the diversity of uses for the computer. It is the responsibility of educators to decide which aspects of these fields are useful and to build on existing strengths [8].

Although, each institution must work toward certain objectives which meet the needs of the students and the faculty, there are some common goals.

1. To provide access to computers and communication systems to students and faculty.

2. To develop new courses of study which are technologically oriented.

3. To integrate the new technology as subject matter into

existing courses of study when applicable.

4. To promote and stimulate research for students and faculty to explore and develop new uses for the medium.

5. To teach the necessary information and skills in the newer technology that are applicable to creative and functional use in the arts.

6. To create an environment and facilities which enhance and promote the artistic use of technology in the arts.

7. To promote interaction between different disciplines to strengthen the program as a whole.

8. To provide in-service or continuing education in the new technology for faculty.

9. To continue work in the development of curriculum.

10. To create organizational structure within the institution which facilitates meeting all objectives.

Curriculum Structure

Once it is determined there is a need for computer graphics, and goals have been established, curriculum design becomes the next issue. Madeja explains that educational problem is how to translate in a practical way the applications of new media devices to the taching of art at all levels for the tachers and the student.

Many colleges and universities are faced with this problem of how to integrate this new technology into the classroom. Some schools have chosen to simply insert or add classes to the already existing art, design, engineering, or computer science curricula. Other institutions have chosen a less traditional approach by creating an entirely new department, based entirely on computer graphics. Robin King of Sheridan College describes the problem stating,

> With the absence of any prototype or network on which to build, the problems involved in the development and implementation of a program in computer graphics for professionals and students of visual arts have provided a number of very significant challenges [12].

King also stresses the fact that each program should be different because each is developed and based on the separate goals and strengths of the institution. Each institution also faces a different set of problems and is geared for a different marketplace.

For presentation of the results, schools which responded to the survey are grouped by country. The majority of institutions examined are in the United States. Institutions from Canada, England, and New Zealand are also reviewed in order to see how other countries are responding to high technology in the arts.

In order to remain impartial and objective, I have purposely not included the computer graphics program at Ohio State University. I would like to acknowledge that Ohio State has an excellent program. Information on computer graphics at Ohio State can be obtained by contacting:

Dr. Thomas Linehan
Computer Graphics Research Group
Cranston Center
1501 Neil Avenue
Columbus, Ohio 43201

The results printed in the following chapters should provide new insight into curriculum development and design. Every institution which implements computers into the arts is giving the students an important new tool for the future.

> The computer...is a tool of technology, until it is put in the hands of artist, then it can communicate an idea, it takes in the elements of content, form and composition [4].

CHAPTER 2

United States

New York School of Visual Arts

Program History

The Computer Art program at the School of Visual Arts was started in September 1986. It was developed by Darcy Gerbarg who is currently the acting director. The program is equipped to handle 20 to 30 students per year. The program offers graduate students a M.F.A. in Computer Art.

Objectives

While the positions for artists in production environments are increasing and more fine artists are using computers, few opportunities for serious extended study exist for them. In response to this need and widespread interest in an artist-oriented computer program, the School of Visual Arts, has established a degree program in Computer Art. Students in this program have the opportunity to use and experiment with the latest computer graphics hardware and software in an art context.

Degree Granting Programs

Graduate: Master of Fine Arts in Computer Art.

There is a structured set of courses leading to a degree over a 2 years, 4 semester time frame. All candidates for the MFA degree must complete 64 credit hours over a minimum of 2 years.

Curriculum

MFA Curriculum

---Year One - Semester One---

History and Evolution of Computer Graphics	(credits)	4
Programming 1		4
Computers in the Studio 1		4
Introduction to Computer Related Technology		4

---Year One - Semester Two---

Critical Issues 1	4
Programming 2	4
Computers in the Studio 2	4
Laboratory: Independent Projects	4

---Year Two - Semester One---

Advanced programming 1	4
Internship	4
Evaluation of Equipment and Techniques	4
Experimental Computer Graphics Workshop 1	4

---Year Two - Semester Two---

Advanced Programming 2	4
Critical Issues 2	4
Experimental Computer Graphics Workshop 2	4
Final Project/Portfolio	4
	64

Core Courses

History and Evolution of Computer Graphics

The history of computer graphics is one of collaboration among artists and scientists. The products of these joint efforts are both artworks and tools. Since future possibilities in the arts are often influenced by historical tradition, it is important that students become aware of the impact art and artists have had on this field. Generally, artworks typify the state of the technology at the time of their creation. Students need to see these works and to gain an understanding of where in the history of art computer graphics lies and where in the continuum their own efforts fit.

Programming 1

An introductory course in programming. Students are exposed to several languages including Pascal and C. In addition, various operating systems, including Unix, are introduced along with text editors and word processing applications.

Computers in the Studio 1

Paint systems are introduced in this course and their use in specific media is explored. This course is intended to stimulate students to experiment with computer tools as an essential part of their creative efforts. Each year a different studio discipline such as printmaking, painting, or photography is chosen by the faculty for special emphasis.

Introduction to Computer-Related Technologies

The artistic possibilities of computers are, in large part, determined by the limits of the tools currently in use. This course introduces students to the most current technologies available. These technologies include video tape recording and editing, video disks, film, laser scanners and recorders, typesetting and printing equipment. The range of technologies is enhanced by guest speakers, demonstrations and presentations from industry, and visits to state-of-the-art facilities.

Critical Issues 1

New issues have been raised by the advent of computers and their use in the arts. Class discussions include presentations from visiting distinguished critics, curators, philosophers and artists.

Programming 2

A continuation of Programming 1. When learning any language, practice is essential. Students complete intermediate programming assignments and the mathematics required for graphics will be introduced.

Computers in the Studio 2

A continuation of Computer in the Studio 1. Since students are working in a medium with which they may not have had prior experience and since they may also be using paint systems for the first time, a full year is needed to produce work in sufficient quantity.

Laboratory - Independent Projects

In this course, students have the opportunity, under close faculty supervision, to explore the use of 2d paint systems in the chosen art specialty.

Advanced Programming 1

Students begin using their programming skills at an advanced level, applying the mathematics and principles of programming to 2D applications including animation. Specialized computer graphics hardware is introduced.

Internship

Students have the opportunity to work in a professional computer graphics facility or in an artist's studio. If a suitable internship is not available in the students' specialty or if it is deemed desirable, the student can choose to take this course in the experimental research laboratory under the supervision of a faculty member.

Evaluation of Equipment and Techniques

Since computer graphics technology is constantly changing, it is important for students to learn not only how to use specific equipment, but also the principles and techniques that can be applied to all systems. We have many systems in the laboratory, from many manufacturers and software housed, for students to explore and evaluate. Students perform the essential tasks inherent in beta testing and develop the skills needed for intelligent hardware and software recommendations.

Experimental Computer Graphics Workshop 1

Continues the work begun in Laboratory:Independent Projects. Students submit a research proposal for approval by the Director of a core faculty member in the program. Working closely with the faculty member, this project should reflect the student's awareness of computer graphics and its potential use in the student's art specialty.

Advanced Programming 2

This programming course covers the fundamentals of 3d modeling and animation. Students are introduced to the hardware specific to this application.

Critical Issues 2

This course pursues the issues raised in Critical Issues 1 as they relate directly to the work being produced by the students. Leading researchers, artists, directors and critics are invited to give presentations and to critique student work.

Experimental Computer Graphics Workshop 2

The second semester of a full year course. During this second semester the student should be achieving the goals outlined in their proposal.

Final Project - Portfolio

This presentation is the culmination of graduate study in this program. Students must submint a substantial and accomplished body of artwork to the faculty for final review and approval. A written thesis may be required if the research warrants. Students whose work is intended primarily for commercial applications present a professional portfolio as their final project.

Interdisciplinary Structure

The curriculum is somewhat interdisciplinary in that it focuses on three areas of interest to artists seeking proficiency with computer tools and successful art careers. These areas are:

1. Computer graphics technology, including programming and hardware configuration.

2. The history of computers in the arts with attention to aesthetic issues.

3. Practical workshops, including internships, in which students produce a substantial body of work in the art specialty and acquire experience in professional studios.

Faculty and Staff

The Computer Art program is run by the Director and is staffed by 4 part-time Faculty members. The Faculty members are also all working professionals. A part-time hardware person and a software consultant round out the staff.

Admission Requirements

1. Applicants must have a BFA, BA, or a BS degree from an accredited college or university, or a diploma from a four-year professional art school including 30 credits in studio art and art history. Formal study of computer graphics or related subjects is helpful but not required.

2. Official transcripts from all colleges and universities attended for the undergraduate degree are required. Students with a 3.0 grade average or above will be given more serious consideration.

3. Letters of recommendation from three instructors or practicing professionals are required.

4. Examples of recent work are required. Applicants may submit slides of recent artwork and/or copies of programs.

Student Selection Procedures

Student selections are based on grade point average, art portfolio, computer experience, and personal interviews. The program is set up for 20 - 30 graduate students. Currently during the first year there are 20 students.

Systems - Hardware/Software

The majority of the hardware is AT&T and Sun workstations. There are several paint systems also available. Proprietary software is used. At this time no software has been written by the students.

The School of the Art Institute of Chicago

Program History

The Computer Graphics program at the Art Institute of Chicago grew out of an area called Gernerative Systems in the late 1970's. Sonya Sheridan taught the original class in technology called Imaging processing using machines such as Xerox copiers. In 1979, Joan Truckenbrod began teaching the first computer art class called Experimental Computer Imaging. Ms. Truckenbrod combined her graduate work on Apple computers with the talent and equipment from the Video Department, and Computer Graphics were a reality at the Art Institute. Ms. Truckenbrod was made area head of Computer Graphics, and continued adding courses and staff whenever appropriate, in order to bring the program to its present state.

Program Objectives

The objectives of the Art and Technology Program at the Art Institute are:

1. To provide a unique scope of ideas that stimulate creative thinking and challenge students to explore new directions in the arts.

2. To develop a research environment that provides resources and knowledge for innovative applications programming and development.

3. To provide leadership in the integration of computing technology into the arts and design areas.

Degree Granting Programs

Undergraduate: B.F.A. in Computer Imaging.

The B.F.A. requires 132 hours of undergraduate work.

Graduate: M.A. and M.F.A. in Computer Imaging.

The M.A. requires 30 hours of graduate courses and The M.F.A requires 60 credit hours.

Curriculum

Art and Technology Studies(ATS) 101(A&B) Experimental Computer Imaging

Students experiment with numerous ways of creating and manipulating images, figures, or compositions with the aid of the computer. Programming skills are not necessary. Such devices as a video digitizer, a digitizing tablet, a light pen, sound generator, video display, printer and plotter are explored.

ATS 102 Computer Language Workshop

Students develop and carry out projects in the arts using programming skills. Students are guided in using the computer programming languages as systems of notation to choreograph events external to the computer. The languages of LOGO, PASCAL, AND FORTH are studied for their potential in the Arts.

ATS 103 Computer Language Projects

Selected projects using the languages learned in Computer Language Workshop

ATS 104 Computer Graphics Programming

This is a beginning course in computer graphics programming. Students will study the fundamentals of computer graphics involving the construction of a figure or object in two and three dimensional space, moving or translating a figure or object, scaling a figure, rotating a figure in two or three dimensional space and transforming the shape of an object. The programming techniques necessary to create a figure, move it about in space and transform it will be presented. Students will develop the own graphics programs using these techniques.

ATS 201 Interactive Computer Animation

Programming course using Amiga and Modula 2. Students work at the keyboard writing programs that use routines supplied by the instructor.

ATS 203 Motion Graphics

This course studies the visual effects of objects or figures moving in three-dimensional space. Simultaneous changes in the size, position, and orientation of an object can be achieved with the aid of a computer system to create dynamic visual effects. Computer graphic systems provide a valuable tool for creating animated

effects for television, advertising, video games, educational programming and film. Students will be involved in developing routines for animation software.

ATS 207 Experimental Robotics

Students will study the relationship of robotics to kinetic sculpture, computer programming languages developed for robotics and their connection to the arts, and the implications of technology for the artist in a broad range of areas. Inexpensive robots will be constructed and programmed in order to study to electronic design as well as the programming aspects of robotics. The relationship between programming languages developed for robotics and artificial intelligence will be examined and discussed in the class.

ATS 304 Digital Video

A comprehensive introduction to the techniques of generating and manipulating electronic imagery (video) by means of digital instrumentation. Attention will be given both to hardware display concepts and software techniques. Principles will be emphasized through construction in class of low cost working digital video devices suitable for artistic uses.

ATS 308 Video Effects Programming

Combining synthesized computer images with live video.

ATS 311 Computer Animation

This course interfaces the techniques of the animated film with those of microcomputing. Students will explore the concept of figure transformation and will create animated sequences based on various aspects of shape and form transformation. Students will create figures or objects for the key frame of the animation and the computer will be used to create the in-betweens, the sequence of figures between the key frames. Each frame will be drawn with the aid of a pen plotter an transferred to film. Emphasis on the visual dynamics of transformations.

ATS 315 Advanced Computer Imaging

The objective of this course is to explore and develop advanced imaging techniques using a series of computing devices integrated through a sophisticated

digital image synthesis device. This course requires a basic understanding of video digitizers, tablet digitizers and image transformation software. Focus is on multi-dimensional imagery, a synthesizing layers of imagery and ideas through the aid of a computer graphics system. The concept of synthetic environments will be explored with transparent and translucent images layered in computer space.

ATS 320 Interactive Environmental Imaging

Using Amigas, students capture information from the environment and develop programs around the data. For example, students use the data from a motion study to creat a new image or sound experience.

ATS 401 Advanced Art and Technology Studies

This is an advanced course considering computer application in the arts, including speech synthesis and recognition, computer image processing and pattern recognition, digital-analog image conversion and the integration of sound, image, time and space.

Art Intellegence and the Creative Process

Students compose music or create visuals based on routines supplied by the instructor. Students establish the parameters to develop sound or new images.

Interdisciplinary Structure

The program maintains close interaction with other areas of the curriculum such as communication design, video, sound, holography, film, sculpture and performance, providing a rich environment for interdisciplinary or multi-disciplinary projects.

The Institute also offers an interdisciplinary program called Time Arts. Time Arts was developed specifically for the student who wants to study in two or more areas.

Faculty and Staff

The Faculty consists of the Area Head, one fulltime Teacher, two part-time teachers and one Teaching Assistant. Also on staff is a fulltime hardware Technician. Graduate Students are also used in assistant positions or as lab monitors.

Admission Requirements

---Graduate---

1. Undergraduate Degree.
2. Portfolio showing field of expertise.
3. Three letters of recommendation.
4. Statement of intent.

---Undergraduate---

1. High School transcripts.
2. SAT scores.
3. Personal statement of intent.
4. Portfolio.
5. Three letters of recommendation.

Student Selection Procedures

Undergraduate students are selected based on their grades, portfolios and purpose of study. Graduates selections are based on the students experience in Computer Graphics and on their portfolio. The Graduate candidates portfolios are reviewed by the faculty.

Systems - Hardware/Software

1. Eight Apple Computer systems with Number Nine Graphics Systems,RGB monotors, mouse devices, Bolex camera and Dunn film recorder.

2. Ten Apple systems with tablets, mouse, video digitizers, robotic device, sound digitizer, and printers.

3. Eight MacIntosh systems with mouse, tablet, video digitizers, optical scanner, and printers.

4. Symtec PGS 111, Using an Apple and a video digitizer.
5. Mindset Computer with a tablet and Lumena Software.
6. Six Amiga Computer systems.
7. Time Arts System with Lumena Software.
8. Cat Digital Image Processing System.

Syracuse University

Program History

The Computer Graphics program was started in 1974 by Joseph Scala as one of the areas within the Experimental Studio Department. The program was discontinued in 1977 when Mr. Scala left the University. Ed Zajec was hired in 1980 to design the program which is currently being offered. Instead of integrating computer graphics into another discipline, Mr. Zajec developed a curriculum specifically around Computer Graphics. The first courses were taught using timesharing on a mainframe (DEC-10).

Objectives

The Computer Graphics area offers a unique, integrated treatment of technical and aesthetic issues, which leads the student towards a unified vision, linking pictorial form with procedural technique. The curriculum aims to promote an in depth understanding of the computer as an image generator, particularly in those areas of image-making, like real time interaction, which only a two way communication medium makes possible. Students will gain proficiency in programming as well as in developing a personal aesthetic according to the principles and practice of computer graphics.

Degree Granting Programs

The Department of Art Media Studies offers a B.F.A. and an M.F.A. in computer graphics. The Department is in the College of Visual and Performing Arts.

Curriculum

B.F.A. - Requirements

The B.F.A. program has a structured set of core courses:

Basic Art Core	30 credit hours
Computer Graphics	18
Required Studio	12
Studio Electives	24
Required Academic	30
Academic Electives	10
TOTAL	124

--- B.F.A. - Undergraduate Courses---

Introductory Computer Graphics for the Visual Arts 231

Basic Fortran Programming tools are acquired while exploring concepts of interaction, picture primitives, picture digitization, picture processing and picture generation within an aesthetic emphasis. Hard copy black and white output using the Dec-10 Computer.

Introductory Computer Graphics for the Visual Arts 232

Modular and serial picturing based on PASCAL structured programming techniques. Fundamental concepts of information theory as applied to aesthetics and initial experiment in interactive visual dialogues. Visual output on CRT display and video tape.

Intermediate Computer Graphics for the Visual Arts 331

Real time picture dynamics are explored in terms of thematic variations and developments. Early abstract films are shown and discussed. Further programming techniques with emphasis on data structures. Visual output on CRT display and video tape.

Intermediate Computer Graphics for the Visual Arts 332

Continued investigation of dynamics, emphasis on paralleling procedural with visual structures. Color mapping techniques are introduced. Visual output on CRT

and video tape.

Advanced Computer Graphics for the Visual Arts 431

Exploration of color passages in time in terms of advanced mapping techniques including transparencies. Focus on system make-up and development in relation to aesthetic issues and individual creative endeavors. RGB color output with several graphics systems hosted by a stand-alone microcomputer.

Advanced Computer Graphics for the Visual Arts 432

The two-way, interactive characteristics of the computer are investigated and given form as dialogues in image generation. Open-form systems are developed based on the delegation of control. RGB color output with several graphics systems hosted by a a stand-alone microcomputer.

M.F.A. Requirements

The M.F.A. program requires a total of 30 credit hours, and two years in residence, with the following area of study.

Computer Graphics	18 credit hours
Art History	3
Graduate Seminar	3
Elective Studio	6
TOTAL	30

---M.F.A. - Graduate Courses---

Graduate Computer Graphics for the Visual Arts 630

Research problems in computer graphics art.
Should be taken for a cumulative maximum of 18 credits.

Graduate Computer Graphics for the Visual Arts 730

Continuation of 630.
Should be taken for a cumulative maximum of 18 credits.

Interdisciplinary Structure

The Computer Graphics curriculum is located in the Department of Art Media Studies(AMP) within the College of Visual and Performing Arts. The Computer Graphics area offers an integrated treatment of technical and aesthetic issues, which leads the student towards a unified vision, linking pictorial form with procedural technique. The courses are part of a departmental media-related focus. The other disciplines within the Department are Photography, Video and Film. Students gain proficiency in programming as well as in developing a personal aesthetic according to the principals of computer graphics.

Faculty and Staff

Mr. Zajec fulfills all of the teaching needs in Computer Graphics. His duties include advising and curricular development as well as teaching. Two Graduate Assistants teach the introductory courses while other students function as lab assistants. Hardware and software maintenance is provided by Syracuse University Academic Computing Services.

Admission Requirements

B.F.A Requirements

There are no specific prerequisites for the admission to the program, however, precedence will be given to applicants with computer experience, and proficiency in at least one of the higher level programming languages.

M.F.A. Requirements

A B.F.A. or related degree is required for entrance into the M.F.A. program. Students with a B.S. in Computer science with a strong interest in art are also admitted.

Student Selection Procedures.

A portfolio of art work is evaluated by the faculty. Precedence will be given to applicants with computer experience, and proficiency in at least one of the higher level programming languages. Computer Graphics at Syracuse attracts an average of thirty applicants of which fifteen are accepted.

Systems- Hardware/Software

The hardware consists of the University's mainframe computers-two IBM 4341's, a DEC-system 10(KL10), and a cluster of Vax 8600's, as well as various frame buffers and a state-of-the-art color graphics system linked to a stand-alone microcomputer. Graphic output is produced on line printers, CRT displays, or videotape. Several Zeniths each hosting a number nine graphics board has recently been added. Software consists of Turbo, Pascal and Multi-Halo.

Carnegie-Mellon University

Program History

Early work in Computer Graphics was done in the late 1970's by Bob Sproull in the Computer Science Department. At the same time, work was also being carried out in the Department of Architecture in solid modeling. Art and Design began using computers in the early 1980's with the development of a paint system. Today, Computer Graphics is being taught in many departments on campus such as Computer Science, Architecture, Art, and Design.

The Department of Design currently offers a Graduate Degree in Computer-Aided Design. The Department of Design is a part of the College of Fine Arts and as such it places great importance on aesthetic and human values. It is part of a high technology university and as such it is the department's intention to promote a significant involvement with the information sciences. The graduate and research activities in the Department of Design are focused on issues of usability in man-machine systems.

Objectives

Enhancement of man's environment is a major design goal. Designers strive to bring a sense of order and usefulness to an environment that includes everthing from geographic surroundings of indiviual rooms to the things we read and use. They try, at the same time, to enrich the environment aesthetically. Carnegie-Mellon attempts to provide an open research environment, encouraging people from various disciplines to pool their knowledge, ideas, and methods to investigate issues within the arts

and sciences.

Degree Granting Programs

Master of Science in Computer-Aided Design

The Master of Science Degree in Computer Aided Design is a structured set of courses requiring four semesters and 132 hours of coursework.

Curriculum

---Prerequisites---

It is assumed that all students will have basic computer and design skills before proceeding with the graduate program.

--- Core (30 units)---

The core is a set of courses which are required of all students.

Writing for the Professions	9 units
Cognitive Psychology	9
Human Factors	9
Graduate Seminar in Design	3
	30

---Emphasis (39 units)---

Individual students will be required to follow one of these two tracks to complement their previous education.

1. Design Emphasis Track:

Design Principles: History of Design	9
Typography	9
Design Studio	12
Drawing	9

39

2. Computer Emphasis Track

Intro to Computing (Pascal)	9
Fundamental Structures of Computer Science	9
Computer Graphics	9
Computer-Aided Design	12
	39

---Electives: (36 units)---

The elective units will usually be satisfied with four courses of the students choosing or from the list of recommeded electives.

---Thesis: (27 units)---

Project and format will be determined by the student and his advisor.

Computer Graphics Courses

---Computer Science Department---

Intoduction to Pascal

Fundamental structure of Computer Science

Fundamental structure of Computer Science 2

Comparative Programming Languages

Artificial Intelligence

Computer Graphics

---College of Fine Arts---

Introduction to design Computing

Computer Modeling in Design

Art and the Computer (Advanced)

Introduction to computer-Aided Design

Computer Aided Design Laboratory

Interdisciplinary Structure

Since its inception, Carnegie-Mellon University(CMU) has provided an open research environment, encouraging people from various disciplines to pool their knowledge, ideas, and methods to investigate issues within the arts and sciences. This environment has spawned numerous interdisciplinary centers that merge traditional fields of study and performance in ways that extend the conceptual and expressive capabilities of all involved. In 1985, CMU established the Center for Art and Technology to further interaction among the arts and sciences. The Center for Art involves departments such as Computer Science, Architecture, Art, Theater, Design and Music.

Faculty and Staff

The Department of Design is structured with a Department Head, and 11 full time Professors as well as 2 part-time professors. There are a total of approximately 13 professors in 4 separate departments who teach Computer Graphics to some extent. The departments involved are Design, Art, Architecture, and Computer Science.

Admission Requirements

1. Degree: BS in a computer related field or a BFA in a design related field or equivalent.

2. Recommendations (3 letters).

3. A Graduate Study Plan (Letter of intent).

4. Portfolio - 20 slides representing design ability.

5. Transcript of college level courses.

6. Current Resume

Student Selection Procedures

Entry into the Department of Design is based on the students' creative potential as expressed in their portfolios, as well as their academic potential. There are 4-6 Graduate Students selected each year.

Systems - Hardware/Software

Computing facilities include numerous large main-frame computers, including DEC-10's, DEC-20's, VAX 11/780's, and an IBM 3083. On campus facilities for computer graphics include Silicon Graphics Iris 1400 workstations, a Ridge 32c computer system, an IB/CADAM computer-aided design system with two stations, seven AED-512 color raster-graphic terminals, Sun workstations having black and white high resolution graphic screens, four Tektronix vector graphic terminals, five Visual 500 graphic terminals, Calcomp and Hewlett Packard pen plotters, Xerox Dover and 9700 laser printers, and Matrix Instruments and Lang film recorders. Apple Macitosh and IBM Pc's are also used.

The majority of software tools available were developed by CMU students, faculty and staff, and include programs for graphic design, three-dimensional solids modeling, painting, animation, text composition, and font design. Auto-cad, pagemaker, file vision, and various Macintosh software is also used.

University of Missouri-Columbia

Program History

A long range plan for integrating computing into the Housing and Interior Design Department was recently completed. The plan is intended to be implemented through introducing computing into almost all the courses in the Department over a period of several years. The integration of computing into the curriculum actually was begun about a dozen years ago. Computer Graphics was introduced into the Department of Housing and Interior Design in the early 70's by Richard Helmick. Helmick taught Introduction to Computer Graphics, using basic key punch technology and a plotter, and offered the class as an elective for students. At that time a separate course in computer graphic applications to design was introduced

as an elective course. The course has developed and changed over the years to utilize new technology, in particular microcomputers. In the past few years microcomputing has also been used in several existing courses.

The recently completed plan is based on more extensive use of microcomputing, utilizing mainly MacIntoshes and IBM-PC's. An unusual aspect of the curriculum plan is that it includes faculty already using computers as well as retooling all the remaining faculty in the department.

Objectives

There are two major objectives:

1. The purpose of introducing computers into the program is to enhance student learning through use of computing as an aid in creative design and design management processes.

2. To introduce the use of computing into almost all the courses in Housing and Interior Design over a period of several years.

Degree Granting Programs

Undergraduate: B.S. in Housing and Interior Design.

Graduate: M.A. and M.S. in Housing and Interior Design.

The Undergraduate degree is based on a very structured set of courses which incorporate Computer Graphics. The Graduate degrees are structured individually and can include Computer Graphics if the student is interested in pursuing that direction.

Curriculum

Undergraduate Courses

Courses will be described in terms of how the computer will be intergrated into the already existing curriculum. Computing will be integrated into the following classes:

HID 40 Foundations for Design

Introduce 2-D design development and 3-D visualization and development.

HID 141 Resources and Materials

Use of computer spreadsheet to estimate amount of materials/spec preparation.

HID 146 Design Business practices

Use the computer spreadsheet for cost estimate/schedule management. Use of the computer word processor.

HID 147 Interior Design 1

Using drawing software for floorplan development and drafting. Use computers for design development.

HID 244 History of HID

Use computers to organize research papers, word processing, and on-line literary search.

HID 247 Interior Design 2

Allow students to use computer aids in analyzing design information.

HID 248 Housing Design 1

Use drafting software to develop and draft floorplans.

HID 341 Computer Graphic Applications to Design

3-D paint and animation on micros.

HID 342 Design Communication

Using Macintosh, IBM-PC, and mainframe for frame work for perspectives. Also use paint systems to develop wire frame 3-D into finished perspective.

HID 347 Interior Design 3

Allow students to use any previously learned computer skills as tools to complete assigned projects: Designing and drafting floorplans, framework, and finished perspective drawings.

HID 348 Housing Design 2

HID 349 Advanced Design Studio

Allow students to use any previously learned computer skills as tools to complete assigned projects: Designing and drafting floorplans, framework, and finished perspective drawings. Cost and material estimation.

Interdisciplinary Structure

Computer graphics in the Department of Housing and Interior Design often involves other departments. The Faculty has formed a Special Interest Group in computer graphics with several other departments who are also involved in computer graphics research. Departments such as Art, Journalism, Engineering, Design, Computer Science and others have formed this group for the development of the Faculty.

The Department of Housing and Interior Design is also involved with the other departments through General Studies. Students from other disciplines can design their own program and include computer graphics.

Faculty and Staff

There are currently three faculty members in the Department of Housing and Interior Design that teach some form of computer graphics. Maintenence of the hardware is taken care of by the University.

Admission Requirements

Admission to the Undergraduate program in Housing and Interior design is open to all incoming students who meet standard University requirements.

Admission to the Graduate program requires:

1. Undergraduate degree.

2. GRE test results.

Student Selection Procedures

The program at the University of Missouri-Columbia has approximately 40 Undergraduates and 6 Graduates. Graduates are selected on the basis of the following:

1. A portfolio of sample work to be assessed by the faculty.

2. A written statement of intent.

3. Appropriate grades on GRE test and undergraduate courses.

Systems

The Program is weighted heavily towards the use of the Apple Macintosh computer. The program also uses a several IBM Pc's. An Artronics system is also available to students on a fee system. Software consists of Mac-draw, paint, space, Easy 3D, Mac 3D, and Commercial Interiors. Auto-cad and Doctor Halo are also used.

University of Oregon

Program History

The University of Oregon has been in the planning and proposal stages of a computer graphics area for several years. A proposal was written in 1985 to establish a Master of Science degree in Computer Graphics in the Visual Arts and Environmental Design. The proposed program focuses on the use of computer graphics in the visual arts, environmental design and art education fields. The program philosophy builds on traditional values, philosophy and content of the School of Architecture and Allied Arts. The program takes advantage of existing course work in Fine Arts, Architecture, Art Education and Landscape Architecture. Funding for this program will provide several new courses to fill out the curriculum. Funding for the Masters program will also provide several new faculty positions .

Objectives

The major objectives of the Computer Graphics program are:

1. To foster an understanding of computer software and hardware on three fundamental levels:

   a. The use and application of existing technology.

   b. The improvement and modification of available technology from the point of view of the artist, environmental designer and art educator.

c. The influence of the artist, environmental designer and art educator on technological development.

2. To explore and develop computer applications in the areas of art, environmental design and panning.

3. To teach the use of computers as educational tools in art, environmental design and art education.

4. To increase and augment institutional access to the latest computer graphics technology for art, environmental design and art education students.

5. To provide an opportunity and a place for the re-education of art, environmental design and art education professionals.

Degree Granting Programs

Master of Science Degree: Computer Graphics in the Visual Arts and Environmental Design.

Each student's course of study is a highly individualized, planned program built around an integrated group of core courses.

Curriculum

This Master's Degree requires a minimum of 48 graduate credit hours. The proposed course of study consists of five specific by related phases:

Prerequisites	
Core courses	21 credit hours
Concentration areas	12
Internship	9
Terminal project	6 to 9
	48 credit hours or more

---Phase One - Prerequisites---

The first phase involves individual counseling with the program adviser to establish which of the Prerequisite courses have been met and which still need to be taken.

---Phase Two - Core Courses - 21 hours---

Core courses are designed to give students an understanding of fundamental concepts, a knowledge of basic terminology, and awareness of broad applications in computer graphics.

Architecture and Allied Arts(AAA) 410G Microcomputers in the Design Process

The introduction of the terminology of small computer systems, their operation, and their applications for artists and architects. A variety of computer programs are reviewed and demonstrated.

ARTV 410G Communication Graphics

The introduction of the design processes which are needed for the development of computer graphics. Topics covered are: perception, design principles, human response and functional aspects of design, layouts and grids, introduction of type, use of images and words, visual communication and organization of information.

ARTV 410G Graphic Design Programming 1, 2, 3

Programming fundamentals through advanced use of programming languages.

ARE 410G Computer Graphics in Art and Design: a History

This course examines the evolution of computer imagery in the fields of art and design. The people, places, and processes relative to computer graphics are explored.

ARE 410G Research Methods: Computer Graphics in the Visual Arts, Environmental Design, and Art Education

Computer graphics in the visual arts, environmental design, and art education and the fundamental methodologies of scientific inquiry relative in each of these areas are studied with attention to their application to research in computer graphics in art and design. Emphasis is on research proposals and critique of the reports.

AAA 410G Contemporary Issues

Contemporary Issues in computer graphics.

---Phase Three - Concentration Areas - 12 hours required---

Phase Three consists of twelve hours of course work in an area of concentration selected in consultation with the program advisor. Because of the interdisciplinary nature of computer graphics, specific courses are not suggested in this section but possible topics ar listed.

1. Two and three dimensional animation.

2. Two dimensional drafting.

3. Three dimensional modeling and simulation.

4. Graphic design and letterform, and typesetting (digital typography).

5. Educational presentation graphics.

6. Business information display.

7. Human figure modeling.

8. Human/machine interface.

9. Modeling for site and landscape planning analysis and landscape mapping.

10. Image analysis and enhancement.

---Phase Four - Internship - 9 hours required---

Following completion of all course work, phase four requires nine hours of internship. The internship may take place on of off campus and will be determined with the aid of the program advisor. Internship assignments will be designed to build upon the selected Concentration Area and lead into the Terminal Project. Students will write a proposal for the internship work and submit a final report at the completion of the experience to the program advisor and the Intership site coordinator.

---Phase Five - Terminal Project/Thesis-6 to 9 hours required---

Phase Five requires 6 to 9 hours of work on a Terminal Project of Thesis. The topic of this project/thesis is selected in consultation with the program advisor and should be related to the Internship experience and to the selected Concentration Area. As a final requirement for the degree, students will present an oral review of the project or thesis and submit a written support document describing the project or thesis to the department.

Interdisciplinary Structure

The proposed program is offered through the School of Architecture and Allied Arts(AAA). Courses relate to three general areas: Fine Arts, Environmental Design and Planning, and Art Education. Departments directly involved in the initial phase of the program are Fine Arts, Architecture, Art Education, and Landscape Architecture. Planning, Public Policy and Management, and Art history are anticipated additions as the program matures within the School.

Faculty and Staff

The program becomes a new administrative unit under the Dean of Architecture and Allied Arts, and requires a director for program management. An advisory committee is also needed consisting of not fewer than three members. Both the program director and the advisory committee members are to be selected from instructors of computer-related AAA courses by the Dean in consultation with AAA.

Funding for the Masters program will provide several new faculty positions . The proposed Computer Graphics Institute would be comprised of seven full time employees including the Director, Secretary, two Instructors, two GTF/GRF, and a Programmer. There would also be 3 half time positions as Software Manager, Hardware Designer, and Technician. A Photographer at quarter time would also be needed.

Admission Requirements

1. Completion of a B.S./B.A or B.F.A. degree

2. A portfolio of sample work demonstrating excellence in visual art, environmental design, and/or art education, or evidence of skill in computer science demonstrated through a portfolio of programs.

3. A written statement describing past experience leading

to interest in the degree and the goals you intent to accomplish through participation in the program.

4. Transcripts from all previous college work.

5. Three letters of reference.

Student Selection Procedures

In general, preference will be given to students with demonstrated abilities in visual art, environmental design, art education or in computer science and who show the greatest promise of professional development through participation in the program.

Enrollment limits will be established to accommodate the availability of equipment, facilities, resources and instructional staff. We anticipate that enrollments will begin small (10-20 students) and increase gradually until an enrollment of 60 is achieved.

Courses relate to three general areas: Fine Arts, Environmental Design and Planning, and Art Education. The program is not oriented toward engineering applications.

Systems - Hardware/Software

The computer lab facilities include an advanced lab containing two Vectrix color computers, a Tektronix terminal, and a Versa-Cad system. Teaching labs contain Apple 2, Macintosh, IBM, Commodore 64, and Atari equipment.

CHAPTER 3

England

Program History

In England, the computer graphics situation is beyond the planning stages with several schools having completed substantial research. The Government has been insrumental in providing incentive by designating design education as one of the important growth areas and by setting strict guidelines for the use of new technology. Only a few institutions, such as Middlesex Polytechnic and the Royal College of Art, have established successful programs. For the most part, the early 1980's were used as a time of planning and evaluation for most of the art and design institutions.

Planning Procedures

England, like most other countries has also been trying to deal with the problem of incorporating technology into its colleges and universities. The Inner London Education Authority (ILEA), a group consisting of six art and design schools, held regular meetings on the subject of computer education from November 1982 to June 1983. Their findings, published the Summer of 1983, was titled, Report on Computer Education in art and design. The schools taking part were Cheslsea School of Art, St Martin's School of Art, London College of Printing, Central School of art and design, Camberwell School of Art and Crafts, and London College of Furniture.

The report presents their view on the needs arising from the application of computing methods to art and design education. The report states that colleges which are engaged in a substantial proportion of advanced work, have only a fraction of the equipment needed. The problem stems from lack of planning and co-ordination in the overall balance of the equipment provided. The ILEA recommends that

> Educational needs would be better satisfied in the future, if an overall policy for the provision of computing equipment for colleges were to be

established [3].

The role of computing in art and design is justified as playing a role of ever increasing importance. This point is emphasized stating,

> ...any College seeking to provide an education with a vocational element, cannot afford to ignore current developments in micro-technology when developing existing and new courses [3].

The report also presents a strong link between education and industry.

> ...Industry and Commerce will increasingly show a preference for those College leavers, who can demonstrate an ability to cope with the present and future demands of technology [3].

> The ability of the computer to obtain and process information quickly is evident and can play an important role in the educational process. This quick information access is seen as a skill that all design courses should seek to foster and extend.

Needs Assesment

The ILEA attempted to asses the needs of the Colleges by grouping courses with regard to their computing and professional needs. The groupings are as follows:

Group 1

Group 1 consists of the following areas; Graphic Design, Photography, Film and Television, Painting, Printmaking, Stained Glass, Enamelling.

The computer needs were assesed for each grouping of disciplines. For this group, the requirement is for a two-dimensional capability which combines a very high degree of resolution, a wide range of color selection and display, fast operating speed, a large data storage capacity and the ability to construct and manipulate screen images in non-commercial ways. It is also necessary to have facilities for video and film input and output, plotters, color printers, and Polaroid type hardcopy devices.

Computer Needs of Group 1

1. To generate and store electronic images for TV, video, film and slide production.

2. Animation, for master drawing and inbetweening, cel making, rostrum camera control and projector control.

3. Phototypesetting and page makeup. Digitized phototypesetters with distributed terminals are needed, also page makeup systems, word processors linked to photo-typesetters and digitizing scanners.

4. Professional practice and management and data storage. Micro and mini-computers with telecommunication FAX facilities.

Group 2

Group 2 consists of Industrial Design, Furniture Design, Interior Design, Theatre Design, Ceramics, Silversmithing, Jewellery Design, Sculpture.

This group is predominantly concerned with 3-d design and requires a sophisticated 3-d modelling capability which allows the construction and manipulation of representative shapes and forms.

Computer Needs of Group 2

1. The need is for high resolution ,shape definition and shape manipulation. Computer drafting is also desirable for the support of computer-aided machining.

Group 3

This group consists of Textile Design, Fashion, Clothing Technology, Tailoring.

The majority of computing applications representative of this group could be considered 2-d.

Computer Needs of Group 3

1. There is a need for dedicated software which allows the designer to translate initial concepts into practical design and also generate information suitable for the control of production machinery and equipment.

Recommendations

The ILEA summerized its findings by providing nine recommendations needed to introduce Computer Education into the art and design curricula.

1. Provide Colleges with the hardware and software they need to provide a sound general education in computing methods. Software could be shared and developed on a corporate basis.

2. Provide adequate computing facilities which can provide design support and also support specialist/professional work stations.

3. Provide a locally based mini-computer which will serve at least three graphics terminals, three conventional terminals and one specialist work station.

4. Development of a Steering Committee which would represent all art and design interests. This Committee would establish overall policy with regard to provision and deployment of computing resources for art and design.

5. One member of the academic staff in each College should have a full-time responsibility for the organization and development of curricular activities relating to computers.

6. Specialist technician support should be given to colleges. This support should relate to the level of work and the amount and type of computer equipment in use.

7. Staff development and retraining. Programs should be established which deal with those computer applications of special interest to art and design and cater for specialist groups.

8. Art and design colleges should be provided with the direct support of professional programmers.

9. Direct engineering support should be made available to colleges.

Conclusion

In 1984, one year after the ILEA released its report, the government's Business and Technician

Education Council(BTEC), published a report setting explicit guidelines and requiring the introduction of high technology into all art and design Instituions. The BTEC guidelines were incorporated into the program at Bournemouth and Poole College of Art and Design and will be discussed futher in the following section.

Bournemouth and Poole College of Art and Design

Program History

In 1985, Bournemouth and Poole College of Art and Design of London, released a proposal designed to introduce computers and computer graphics into its curriculum. The report written by Stuart Cox, Coordinator of Studies in Computer Aided Design, was entitled New Technology - A College Strategy. Cox believed that many artists and designers were reluctant to use computer graphics the past few years due to complicated programming requirements and lack of training and equipment. Presently he sees the recent developments such as 'painting' systems and 'solid modeling techniques', which are menu based and easy to use, attracting artists and designers who now recognize the potential of the medium. Cox urgently states,

> It is essential that all students of Art and Design should be aware of and have practical experience of at least those systems relevant to their particular discipline [7].

The proposal was drawn up to meet the specifications set forth earlier that year by a branch of the English government called the Business and Technician Education Council(BTEC). BTEC, much like the Department of Education in the U.S., exists to advance the quality and availability of work related education for those in, or preparing for, employment.

The fundamental aim of the Council is that students on BTEC courses develop the necessary competence in their careers for their own interest, their employers' interest and the national interest. In 1984, the BTEC guidelines provided several explicit requirements for the introduction of high technology.

> Relevant new technology must be brought within the awareness, understanding and experience of both students and staff. Centers will be expected to appreciate the increasing computer literacy of the students they will recruit. They will need to deal imaginatively and constructively with the understanding and applications of computers, CADCAM and other new technologies appropriate to the areas of work within the course. Whenever practical, the Board will expect students to receive hands-on training with computers and other technology appropriate to their field [1].

The guidelines emphasized continued training of students primarily as designers, illustrators, film-makers etc., but with the appreciation and experience of the potential offered by new technology. BTEC wanted

> To ensure that a separate subject,i.e. Computer Studies, is not produced, but that new technology is experienced in a simulated professional or industrial context, as an integral part of the overall design process [1].

These guidelines and the methods employed to integrate new technology into existing course content, became a major influence on new technology strategy at Bournemouthe and Poole.

Program Philosophy

The basic philosophy at Bournemouth and Poole will be founded on a commitment to provide a non-departmental College-wide resource. This will create a focus for inter-disciplinary work throughout the college and provide a catalyst for projects which cut across traditional departmental or even faculty divisions and promote collaborative projects. Collaborative projects should not be limited to inter-departmental considerations, but should involve the college with the professions, industry and other educational establishments. The primary aim is therefore a facility to which all students must have access to as part of their course requirements, and not a selective research facility available to very few students.

Research Objectives

The basic objectives of the reasearch at Bournemouth and Poole was to investigate the current state of the art and available computer systems and to propose a package which would satisfy the full range and diversity of the College and the BTEC requirements. Six objectives were defined as a basis for research:

1. Establish the current and projected future needs of the courses provided by the College.

2. Establish the current and projected future requirements of the industries within which students will seek employment.

3. Consider the necessary adjustments to course content required to meet the needs of the courses and the introduction of new technology.

4. Investigate procedures and methods of implementing new technology, employed by other education authorities and institutions, the professions and industrial bodies.

5. Use the information gained to formulate an optimum package or system.

6. Research an extensive range of equipment which fulfills one or more of the requirements while considering financial and practical factors.

Needs Assesment

There were four departments involved in the introduction to high tech equipment ; Department of Co-ordinated Studies, the Department of Fashion and Interiors, the Department of Graphic Design and Technical Illustration and the Department of Photography, Film and Television. While the specialized needs and applications of new technology differed between departments, it was found that there was a repetition in departmental requirements and an overlapping in the demand for certain facilities. The majority of requirements could be satisfied by adapting standard software and providing adequate hardware which net four common cores of demand.

Proposed Systems

1. Three dimensional drawing and solid modeling system. Wire-frame, hidden-line removal and solid modeling facility. The hub of the system will be two IBM ATE's and

four IBM PC's. The 3D facility will include:

a) Cubicomp solid modeler.

b) An adaption of a communications package of Tektronix emulation system to facilitate use of 3D software.

c) The PICASO system which includes modeling/shading and light source control.

2. Two dimensional drafting systems/CAD. The IBM network will again offer capability to support extensive 2-D aspects available under PICASO, GINO F and GINTRAN. In addition, a specialist 2-D package, AUTOCAD, will be adapted. Each terminal will be accessed from a small CALCOMP digitizer or HOUSTON HIPAD.

3. Comprehensive video-based paint system, including animation and text facilities for video. A Quantel digital Paint Box is the most competent system which is also video based. A Gibetwekk 3000 output camera will be required for hard copy and a high quality Barco (RGB) Monitor. Also required will be a video recorder and a time base corrector.

4. Extensive and compatible word processing/page design/phototypesetting systems. The IBM will provide access to word processing, page composition and typesetting equipment. The Visutek/Scantex or Compugraphic Laser typesetter would be used.

Faculty and Staff

An extensive program of staff training is essential once the equipment is installed. This is a crucial factor in the application of new technology and will influence the success of the resource.

> It is important for teaching staff to be not only professionals within the intended area of study, but also proficient operators of relevant systems [7].

To minimize Staff training time, and to achieve maximum efficiency of operation by both staff and students, the majority of recommended systems are controlled by digitizers, touch pens etc., avoiding

extensive keyboard operation. The proposed installation will require a high degree of systems management, maintenance and general upkeep. A minimum of three new fulltime staff positions is necessary:

1. Experienced technician to deal with typesetting and associated equipment.

2. Technician/research assistant with experience in electronics and video/TV engineering techniques, to provide hardware maintenance.

3. Research assistant/technician with experience of software development and knowledge of hardware.

Conclusion

Bournemouth and Poole concedes that the proposed system constitutes a catching up exercise to at least a level comparable with other colleges. Bournemouth & Poole also believe that that the opportunity to integrate new technology is unique and that maximum benefits could be derived if the proposal is put into effect.

> The College can effectively leap-frog from its current position to one which should enable it to become a center for new technology applications [7].

CHAPTER 4

New Zealand

New Zealand - History

The use of computer graphics in the design curriculum in New Zealand Technical Institutions stared as early as 1974. Although some progress has been made to introduce computers into the Institutes' art and design courses, progress has been slow. Dr. Thomas Linehan, a Fulbright Research Scholar, has just completed three months of research on the role of computer graphics in New Zealand's Technical Institutes. As Dr Linehan states,

> Computer implementation for design education has occurred in the United States and in many European countries in a poorly planned and often wasteful manner [14].

With a careful assessment of needs and planning, New Zealand may cut through the waste of time and resources. Each institution has already implemented some form of computer graphics into their curriculum, but each with different emphasis, and each with varying amounts of success.

Methods of Research

Linehan's study focused on the following Institutes with three and four year design courses.

Aukland Technical Institute
Carrington Technical Institute
Christchurch Polytechnic
Wellington Polytechnic

Linehan spent three months in New Zealand interviewing teachers and examining current curriculum materials with attention to philosophies, goals, scope, requirements, student populations, and student work. The Interviews and analysis addressed the following questions.

1. Is there existing use of computers in design professional practice or design education?

2. Is there a perceived need for computer implementation in design education?

3: If required, what is the nature of the computer implementation?

4. What are the major educational planning issues involved with computer implementation?

5. What is the nature of technical hardware/software support available to the institutions offering design education?

6. What are the projected industry-business needs for present and future relative to computing and design [14]?

Implementation of Computer Graphics

After completing his interviews and research of the four Institutions, Linehan held a week long in service instructional course for those design educators involved. Speakers included a computer animator, a designer from Television New Zealand, a director from a computer graphics company, and several computer science experts. The educators combined their ideas and goals and developed a common plan on the approach and implementation of computer graphics in Technical Institutes. The plan calls for implementation at four levels:

Level One

Experimental implemantation immediately using the existing resources at each Technical Instututе in collaboration with computer services centers and interested computing tutors. This level is characterized by:

1. Introduction to basic concepts of computing and computer graphics.

2. Viewing examples of computer graphics/animation with critical discussions.

3. Introduction to keyboard skills.

4. Experimental use of "Paint" and other software packages.

Level Two

Introduce design students to basic concepts of computer programming and continue use of varied graphics software packages. This level is characterized by:

1. Building and manipulating simple, three-dimensional objects (scale, translate, and rotate).

2. Use of pagination and typographic software.

3. Use of a frame grabber to capture photographic or video imagery and to integrate these captured images with typography.

4. Continued exploration of varied software.

Level Three

Integrate computer use with design problem solving. This level is characterized by:

1. Elective study of intermediate computer programming.

2. Demonstration of successful use of computer in resolving a major design problem.

3. The use of computer graphics/animation in a design presentation.

Level Four

Establish a Post Graduate Course for designers with a focus on computer graphics design.

This level is characterized by:

1. In-depth study of computer programming as it relates to graphics languages, operating systems and graphics workstations.

2. In-depth study of design research in a computing context. Development of design knowledge and design skills in a computer-aided-design context. Study of design education issues in a computing context.

Educational Planning Issues

Linehan recommends that implementation take place in a coordinated fashion and calls for a conservation of resources and sharing of information and expertise. He stresses the following educational planning issues:

1. Establish an active network of communication between design teachers at the Technical Institutes.

2. Design teachers should establish a strong and continuing relationship with Technical Institute computer services staff and with computing teachers.

3. Provide professional development opportunities and released time for course supervisors and design teachers.

Technical Hardware/Software Support

The implementation is dependent upon access to hardware and to software support. Linehan points out that without an increase in computer resources students are likely to be granted only limited access. He recommends that

> Computing resources and technical support should be provided in coordination with computer center managers at the technical institutes [14].

The concepts Linehan and the teachers of New Zealand have produced are valuable to any university attempting to implement computer graphics. It will be interesting to follow New Zealand's progress for the next several years and find out how well their plan is working and why. Linehan argues that,

> Computing can extend design and design education and can facilitate invention. It is essential that computing access be provided and that the structured instruction be integrated with the existing curriculum [14].

CHAPTER 5

The Interdisciplinary Philosophy

Computer Centers

The term interdisciplinary is an adjective which has been used constantly to describe the field of computer graphics. The dictionary defines this term simply; involving two or more academic areas. Computer graphics is indeed interdisciplinary in that is involves the academic areas of art and science. Joan Truckenbrod describes Computer Graphics as the integration of analytical computer processing with the intuitive creative thinking of art [21].

Computer Graphics may be comprised of art and science, but it reaches into many different and seemingly unrelated areas such as music, architecture, engineering, film, design, computer science and art. While each of these fields has developed in a separate intellectual setting, they all share one common bond; the understanding and challenge of new technology. Each discipline also faces the problem of communication through technology. Every area is independently exploring how to best use technology to solve its problems and communicate its' ideas.

Robin King in his paper A Graduate Level Program in Computer Graphics for the Visual Arts stresses the interdisciplinary theme along with several other important characteristics which he believes every Computer Graphics program should posses:

1. It should be interdisciplinary because the field covers so many specialties within the visual arts.

2. It should have an evolutionary structure because of the need to respond to rapid changes in technology and organizational structure.

3. It should facilitate maximum interactivity among faculty, staff and students.

Now several large universities have taken King's objectives and the interdisciplinary philosophy to its next logical step; the formation of Computer Centers. No longer are these universities combining just two disciplines, but they are combining all of the disciplines which are researching the applications of new technology or computers. The use of computers has become so widespread, that the creation of huge Computer Centers appears to be a logical solution. These centers attempt to combine the computer research from every discipline and house them all under one roof.

The Computer Center idea is structured much like King's Computer Graphics program, but on a grand scale. The major objective therefore is to enhance the interaction between these groups and create a totally interdisciplinary and evolutionary environment. Many educators agree that interactivity between separate disciplines is essential to the success of any interdisciplinary program.

> Cross-discipline conversation between faculty and students from related areas strengthens the program as a whole because they might gain greater understanding from the expertise of other fields [8].

Leeman stresses the need for student interaction stating

> Student-student interaction permits the mutual exchange of ideas, relationships, concepts, modes of visualization and specific knowledge from a wide range of perspectives and background. Students with strengths in programming skills, color theory, and composition are able to exchange and grow through the mutual interaction and thus develop a broad range of skills and concepts otherwise not attainable [13].

Bringing together faculty members who are using computers is the first step of centralizing communication and reinforcing interaction. Centralization provides a sharing of resources, information and new techniques.

While the concept of Computer Centers is quite new, there are already several Universities pioneering the idea. Illinois Institute of Technology(IIT), Massachusetts Institute of Technology(MIT) and Carnegie

Mellon each have their own version of Computer Centers, while other Universities such as Ohio State are in the planning process. This chapter will review IIT's Design Processes Laboratory, MIT's Media Lab, Carnegie Mellon's Center of Art and Technology, and then focus on Ohio State University's Advanced Computing Center for the Arts.

Illinois Institute of Technology - Design Processes Laboratory

The Institute of Design, within the Illinois Institute of Technology(IIT), may have been one of the first institutions to introduce the concept of computer centers.

> In the middle 1960's, The Institute of Design began exploring the role of computers in the design process [2].

Using other departments mainframe computers, the Institute of Design began research into new design tools. By 1970, the first course in computer graphics was taught in the Institute of Design. Also at this time, research continued into computer applications in design as well as into computer graphics.

> By 1980, it was clear that the potential existed to formalize the special interests of the school in design processes [2].

Ray Niacaris, who was on the faculty of the Product and Design Department, began work on a plan to establish a laboratory where computer design methods and capabilities could be studied. Niacaris, also a computer applications specialist for Hewlett-Packard(HP), proposed a grant of equipment from HP to be given to the Institute of Design. With the equipment grant, Niacaris envisioned the creation of the Design Processes Laboratory.

In 1981, HP made its first equipment grant to a design school which resulted in the formation of the Design Processes Laboratory. Since the initial grant worth over one hundred and fifty thousand dollars, the Design Processes Lab has raised over one million dollars

in funds and equipment. Most of the donations have come form private corporations such as Digital Equipment Corporation, Amdek Corporation, Zenith and Herman Miller Corporation.

The Design Processes Laboratory's major objective is to support the study of design processes. Research into computer-supported design applications is the first priority, as equipment and services are reserved for faculty and student research projects. Although there is not the interdisciplinary interaction which exists in many of the newer Computer Centers, the idea to form an area in order to research the applications of new technology may have started at IIT. The Design Processes Lab may also have been the first to establish corporate sponsorship for computer research.

Current Projects

Several important projects have been completed at the Design Processes Laboratory.

A Computer Model for Simulating Human Physical Differences

A three-dimensional computer graphic model designed to control, constrain and simulate complex human (and/or robotic) motions is described. With it, handicaps and special motion limitations relevant to a product being designed can be explored through simulation.

Cellular Models for the Computer Representation of Form

A system of cellular representation is proposed as the most natural way of modeling solid forms for computer-aided design. Instead of manipulating lines and surfaces, designers working with cellular models can work directly in three-dimensional space with material constructed of assemblies of tiny cells. With this process and a special display method, users can work three-dimensionally from two-dimensional graphic terminal.

Massachusetts Institute of Technology - The Media Lab

Massachusetts Institute of Technology(M.I.T.) is one of the originators of the Computer Center approach.

M.I.T.'s center which is the combination of eleven distinct research areas is appropriately called The Media Lab. The Media Lab, which opened early in 1985, was founded by Nicholas Negroponte, an M.I.T. professor of Media Technology, and Jerome Wiesner, President emeritus of M.I.T. The two founders had raised $40 million dollars since 1978 to pay for the Lab's new building and computer equipment. Money was donated from at least forty large corporations including CBS, Digital Equipment, NEC, Appled and Time Inc. Wiesner explains the purpose of the lab stating

> This is an effort to enhance human creative power though computers [23].

The 120 professors, graduate students and administrators have two goals:

1. To create new ways for people to use computers.

2. To make computers as easy to use as possible.

In the beginning, the Media Lab was driven by an interest in bringing the arts and sciences closer together. M.I.T. wanted to couple artistic intuition with advanced scientific and technical thinking. The Media Lab attempted to combine artistic activities such as film, graphics, and music, with the other sophisticated research programs like computer animation, advanced television studies, holography, speech and signal processing, and computer-based learning. The Lab eliminated the isolation of separate departments and fields of research by bringing together the most advanced thinking about applications with the most advanced research in imaging technologies, interactive systems, theories of computation, and the human cognitive system. The groups are: Electronic Publishing, Learning Research, Advanced Television, Computer Music, Spatial Imaging, Graphic, Human-Machine Interface, Telecommunications, Film and Video, Computer Graphics and Animation, and Computers and Entertainment.

Along with creating the Media Lab, M.I.T. has also established a new area call Media Technology. Media Technology is used to mean the information technologies that serve human expression, and is deeply rooted in modern communications, computing, and human sciences.

> Computing, communications, and an understanding of human communication processes are common denominators in the interdisciplinary merger of

formerly separate pursuits.

Media arts and sciences is simply a trend toward increasing the overlap of formerly independent disciplines to create a new and stronger discipline.

Current Projects

This is a sampling of some of the work currently being researched at the Media Lab.

Electronic Publishing - Personalized Newspapers

Personalized Newspapers is an example of an idiosyncratic agent that sifts nightly through the world news to prepare an individualized, full color morning newspaper, inclusive of non-newsworthy but personally important information of the day.

The Human-Machine interface

M.I.T.'s Human Machine Interface Group is attempting to perfect computers that will move objects on command, talk and read lips.

Television Better Than Movies

The Advanced Television Research Program is directed to improving television's image, motion and sound quality. A simulator is currently under design which will allow aspect ratio, frame rate, and number of scan lines to be independently variable, capable of exploring systems with greater quality than the highest high-definition systems proposed to date.

Synthetic Performer

The Media Lab is pursuing a new approach in computer music, that of making the computer understand enough about the group dynamics of music performance so that it can be a skilled synthetic performer. The computer will be capable of processing acoustical signals alone, and fast enough to accompany a human partner.

The Technology of Apparition

The Spatial Imaging Group is studying the application of modern laser optical techniques as well as the latest advances in holography. There is an emphasis on the translation of computer graphics into fully three-

dimensional form. The long-term goal is to push the technologies of computer modeling and applied physics together to the point of making moving, full-color synthetic holograms possible in real-time.

Drama Without Actors

The Computers and Entertainment group is working on the simulation of theatrical performance by computers. The objective to be able to script and act a drama without actors, through computer generated imagery and speech.

Carnegie-Mellon - The Center for Art and Technology

Carnegie-Mellon University has since its inception encouraged interdisciplinary research with which to better investigate issues within the arts and sciences. In 1985, CMU established the Center for Art and Technology to further interaction among the arts and sciences. The Center for Art and Technology is investigating applications of advanced technology to numerous artistic domains, including modeling, sound, image-making, and information sharing and hiding. The Center is an interdisciplinary environment which merges the traditional fields of Architecture, Art, Design, Theater, History of Art, and Music.

Objectives

The objective of The Center for Art and Technology is to provide an open research environment, encouraging people from various disciplines to pool their knowledge, ideas, and methods to investigate issues within the arts and sciences.

Current Projects

Several current projects which are underway in the Center for Art and Technology are:

The Architect's Generative Expert System

Captures and uses the expertise that goes into the design of an architectural layout. Based on artificial intelligence, it uses techniques of expert systems that make it easy to encode this knowledge and to subsequently

test it on realistic problems.

Panda

A versatile painting and drawing access system used in the Department of Art for classes in which students from both art and science disciplines join in an exploration of the creative potential of the computer as an artistic tool. A menu and palette provide a variety of marks, line styles, shape generators, and color choices, all of which can be used easily and with little training.

Automated Presentation

Using mass storage and quick retrieval systems to overcome problems of data storage and presentation. The system addresses ways to edit material recorded on videodisks to increase the rate of production for instruction.

Automated Publishing

Allows text and graphics to be shared by author, editor, and designer as work is proceeding. Words are assembled and merged with figures, sentences are colored and boxed off, text fonts are previewed, changed, and selected-information is shared.

Vega

A tool to aid architects in viewing designs three-dimensionally. Vega is a utility system for creating geometric models of buildings and 3-D assemblies. Though Vega, a designer can access needed geometric information quickly and easily.

Theater Design Project

Enables theater production details to be executed in a more organized and time-saving manner due to computerization. A stage designer, costume designer and lighting designer all develop their designs and ideas simultaneously on the computer.

The Designers Toolkit

A designer uses a 3-D graphics editor to assemble large, loose concepts representing surfaces. Objects can be cut from one design and pasted onto another, allowing for multiple trial combinations.

Vivace

A rule-base software system that mimics the behavior of human composers and is able to write four-part chorals.

Ohio State University

Ohio State University has recently formed a Computer Center after a year of planning. A proposal to establish an Advanced Computing Center for the Arts was approved in September of 1985. The proposal explains the purpose, rationale, and structure of a large Center for the Computing Arts.

Purpose

An Advanced Computing Center for the Arts serves the following purposes:

1. To apply advances in computer technology to the processes, values, and ideals of the arts.

2. To promote interdisciplinary projects and programs with visual and performing artists, designers, arts historians and critics; and with computer scientists, engineers, and mathematicians.

3. To employ sophisticated computer technology for investigation of artistic production and for evaluation and modes of dissemination.

4. To provide an appropriate administrative unit for relating research and service efforts of faculty members where common strategies exist, where functions are better served through direct relationship, and where multiple missions can be more efficiently served through the structure of a Center.

Rationale

The Ohio State University and the College of the Arts has a long history in the electronic arts. Professor Charles Csuri's work in Computer Graphics in the mid-1960s led the to formation of the Computer Graphics Research Group in the College of the Arts in the 1970s.

> Concurrently, in the late 1970s, emerging interests in experimentation with other visual images and with aural phenomena led to the formation of a loose federation of College of the Arts faculty members within a structure called a Center for Experimental Activities in the Arts. Although research continues to be associated with individual professors, it as apparent that important interdisciplinary efforts are be assisted by the formation of an Advanced Computing Center for the Arts and Design. It is time that we combine existing resources into an entity with strong alliances with artists and those research professors whose activities relate computers to arts processes and products [5].

Administrative Structure

Director

Exercise responsibility to determine function, general direction, and coordination of activity; and develop budget proposals appropriate to function.

Assistant Director

Duties will be those appropriate to such a title with specific responsibilities developed in consultation with the director.

Advisory Committee

Unit formed with representatives from academic units in the college to provide communication and liaison and to participated in planning.

Functions

The Center would provide three major functions :

1. Research and Development.
2. Education and Professional Development.
3. Evaluation and Dissemination of Information.

Research and Development

1. Design and implement programs that can support

applications of an aesthetic nature, so that such applications will preserve culturally acknowledged characteristics, while simultaneously opening new ways of aesthetic expression and/or allowing for new concepts.

2. Research visual communication and semiotic aspects of graphic design, of industrial design, of film and photography.

3. Overcome simple adaptation of devices for artistic or for design purposes by conceiving of new ways machines can be built for supporting art, design, education, and cultural activity.

4. Understand the interaction between humans and various machines and programs; deal with the change brought about by the emergence of soft tools. Research will be started in order to define characteristics of art and design as well as the cognitive aspects of such activities.

5. Basic research in computer graphics.

Education and Professional Development

1. Academic degree programs should be developed with study leading to an interdisciplinary Master of Arts degree and Doctor of Philosophy degree using computing in the arts as the base.

2. Professional development programs open to faculty within the college and other faculty interested in the impact of computers on art and design should be established.

Evaluation and Dissemination of Information

1. Maintain a state-of-the-art system for arts and design professionals as well as for educators.

2. Function as a liaison between educational publishers, software developers, and hardware manufacturers for the artistic and design community.

3. Conduct surveys of needs and services required by art and institutions, artists, designers, and educators.

4. Provide study information to interested parties.

5. Establish a major journal on computing in the arts and

design.

6. Distribute newsletters aimed at diverse levels of expertise within the education community and within industry.

Conclusion

The Center will coordinate in an interdisciplinary and transdisciplinary way, efforts of an educational, scholarly, and practical nature generated by current developments in art and design. It will bring together faculty and students who are willing and able to commit to a difficult and unprecedented task. The principal asset of the Center is the creative potential within the college and the university. This asset can be extended through access to computers and computer-related technology [5].

CHAPTER 6

Conclusion

The information technology of this century has changed the way human beings communicate. Likewise, education has changed in that it has become a function of interaction with this new technology. The educational system has been given the problem of keeping pace with the technology revolution.

Art of the 1980's has also become one of interaction between the artist and technology.

> A new visual language has developed for these technological advances as well as a new set of visual skills and methods that can be taught as part of the visual arts curriculum [17].

While the introduction of new technology into art and design offers opportunities for advancement and creativity, it also poses new problems. The problems created by these technological advances and how universities and colleges have dealt with these challenges, has been the major focus of this thesis. With the constant growth of computers in the arts, educators worldwide have recognized the need to integrate the new technology into their programs. White stresses the concern in the United States saying,

> The American education system will need to redirect its efforts to emerging social and technological realities if it is to fulfill its charge of adequately educating members of our society [22].

Hill expresses his ideas on the Canadian situation,

> If Canada is to catch up to other industrial nations and take the lead in technological innovation, it needs more than the traditional approaches of specialized training and institutionalized research.

In England the governments Business and Technician Council(BTEC) published it's findings,

> Relevant new technology must be brought within the awareness, understanding and experience of both students and staff [1].

The New Zealand study concludes,

> They (designers and artists) must be knowledgable of both the design process and the capabilities of technology. This calls for a change in the way artists and designers are currently trained [14].

John Triplett in studying the computer graphics problem in Australia states,

> We need to educate the community that design is now a high tech area, pencils and paper are no longer enough [20].

It has been well established that computer art or computer graphics has a wide diversity of applications which touch on many different disciplines. Computer graphics can be found in science, art, entertainment, medicine, design and many other areas. It has also been determined that computer graphics needs to be introduced into the educational system.

> The advantages and limitations of these new technologies will force significant departures from current curricula and will demand the development of novel program designs, and new teaching strategies [11].

As was discussed in the first chapter, there is no prototype on which to base a program in computer graphics. It is also apparent that every program is unique in that each has a different rationale and set of objectives.

> In the fields of computer graphics, there are various trends utilizing various techniques. It is the responsibility of educators to decide which aspects of these fields are useful and to build on existing strengths [8].

The diversity of computer graphics applications is reflected in the various types of curricula that have been discussed. A review of the schools surveyed may provide some insight into the process of curriculum design for computer graphics.

New York School of Visual Arts

The program at the School for Visual Arts is in its first year. The program was developed and based entirely on computer art. There is a structured set of courses leading to an M.F.A in Computer Art. The degree requires two years and a minimum of 64 credit hours. Courses consist of History of Computer Graphics, Programming and Independent projects. An Internship and a final Project is required for graduation.

The School of the Art Institute of Chicago

The Computer Graphics program at the Art Institute of Chicago grew out of an existing program of Generative Systems. The program started out with one Computer Graphics class in 1979, and has continued to grow to its current level. The program includes over 15 Computer Graphics related classes including Experimental Computer Imaging, Computer Graphics Programming, and Computer Animation. Two degrees are offered; a B.F.A. in Computer Imaging which requires 132 hours of undergraduate work, and a M.F.A. in Computer Imaging which requires 60 credit hours.

Syracuse University

The Computer Graphics program at Syracuse was originally an outgrowth of the Experimental Studio Department. In 1980, a complete program in Art Media Studies was developed based on Computer Graphics. The program is a combination of Basic Art courses, Studio courses, Required courses, Electives and Computer Graphics courses. Syracuse offers a B.F.A. in Computer Graphics which requires 124 credits with a minimum of 18 in Computer Graphics. An M.F.A. is also offered which consists of 30 credits, 18 of which are in Computer Graphics.

University of Missouri-Columbia

The University of Missouri-Columbia is currently integrating Computer Graphics into the Housing and Interior Design Department. The plan introduces computers into almost every course in the department over a period

of several years. The University grants an undergraduate B.S. in Housing and Interior Design and a M.A. or M.S. in Housing and Interior Design for graduate students.

Carnegie Mellon

Computer Graphics at Carnegie Mellon are very interdisciplinary. Courses are taught in Computer Science, Architecture, Art, and Design. The Design Department is the only area which currently offers a Computer Graphics related degree. A Master of Science in Computer-Aided Design consists of a structured set of courses requiring 132 hours of coursework. The M.S. requires 39 hours of computer oriented coursework from any combination of departments which teach computer related courses.

University of Oregon

The University of Oregon has been teaching Computer Graphics classes for many years. Courses are taught currently taught in Fine Arts, Architecture, Art Education and Landscape Architecture. The University is currently in the planning stages of creating a new Computer Graphics program. A Master of Science in Computer Graphics in the Visual Arts and Environmental Design will be offered. The M.S. will require 48 credit hours.

England

In England, the government has been instrumental in designating new technology for design education as an important growth area. In 1984, the government set strict guidelines for the use of new technology in art and design colleges. The English Government provided grants of money and equipment to colleges who met all the guidelines.

Bournemouth and Poole College of Art and Design

In 1985, Bournemouth and Poole College of Art and Design released its proposal designed to introduce computer graphics into its curriculum and meet government standards. The basic philosophy was to create a non-departmental interdisciplinary resource to promote collaborative projects. The objectives at Bournemouth and Poole was to investigate the current state of the art computer systems and to propose a package which would satisfy the entire college and the government requirements.

Canada

Sheridan College

Sheridan was the first Canadian institution to introduce computer graphics. In 1982, the Sheridan Computer Graphics Laboratory introduced the first graduate level program in computer graphics for the visual arts. In 1985, Sheridan introduced a program in Computer Animation. Sheridan offers a one year program in Computer Graphics and Animation. Courses range from Computer Graphics Technology and Graphics Systems, to Computer Programming and Animation Methodology.

New Zealand

Progress has been slow to introduce computers into the schools of New Zealand. Although Many institutions have some form of computer graphics in their curriculum, there has been no major plan of action until this year. New Zealand is using researchers from other countries such as Thomas Linehan to carefully assess the needs and help propose a strategy. New Zealand may be able to learn from the mistakes of other universities and colleges around the world. The current strategy calls for implementation to take place in a coordinated fashion with the conservation of resources and the sharing of information and expertise.

Future

> The future importance of this medium raises not only issues of computer design, it raises the issue of the medium itself [9].

Computer Graphics is so new and in such a state of change, that it may take 20 to 30 years or more before the medium assumes a separate identity. As Phelan states,

> There is no tradition on which to build a future [19].

Because computers are not readily available for artists and they are expensive, building a tradition or a stable medium may take many years. Again, the role of exploration and development of the new media will fall on educational institutions.

Perhaps the best method in exploring and developing the new media at the university level is through the creation of Computing Centers. As was discussed in Chapter three, centers appear to be a logical step in

combining a medium which consists of many different disciplines. The interdisciplinary philosophy of combining all of the disciplines which are researching the applications of new technology will no doubt result in increased development in the area of computer graphics. The work at MIT's Media Lab and Carnegie Mellon's Center for Art and Technology clearly show a promising new direction in the study and application of computer graphics. These new interdisciplinary and evolutionary environments may be essential to the success and acceptance of computer graphics as a medium of its own.

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APPENDIX A

Computer Graphics Curriculum Survey

1: Program history.

a: How and when did the program start?

b: Were computer graphics classes added to an existing curriculum, or was a new curriculum developed specifically around computer graphics?

c: Were the first computer graphics classes taught on a personal computer, (i.e. apple or IBM) or on a main frame?

1: Program history. d: Were any special courses developed to introduce computer concepts and programming to the students?

e: Were new staff required to teach computer graphics and maintain the computer hardware/software?

f: How was the computer graphics program funded? Was it funded by the institution, the state, or by private donations?

2: Program philosophy.

a: What are the objectives of the computer graphics program?

3: Curriculum and program structure.

a: What degrees are offered? Does your institution offer a degree in computer graphics? What degrees are offered (Please include graduate and undergraduate programs.)

b: Is there a structured set of core courses leading to a degree or can the program be individually designed for each student?

c: Please list computer graphics courses offered with a short synopsis of each.

d: Are courses interdisciplinary or interdepartmental? If yes, what other disciplines or departments are involved?

4: Faculty and Staff.

a: What is the administrative structure of the program? (i.e., Is there a Dean, Director, etc.?)

b: How many faculty members are there and what are their specific roles?

c: Are graduate students used as supplemental staff or teaching assistants? If so, what duties and responsibilities do they have?

5: Student selection procedures.

a: What are the student admission requirements?

b: How are students selected? Are student selections based on grade point average, art portfolio, computer experience, or other such information?

c: What is the average number of applicants and the number of students accepted?

d: Do the majority of students come from one particular discipline? (i.e., Do most students come from an art or computer science background?)

6: Employment opportunities. a: What type of employment can the graduate expect? Is there a common direction or specific type of employment that the graduate can expect? (i.e., Do most graduates become educators, designers, engineers, etc.)

7: Systems.

a: What types of hardware and software are available for the student? Do students develop there own software?

8: Future.

a: What are your plans for growth? What direction will your computer graphics department be taking?

9: Ideas.

a: Can you offer any ideas or advice for a university that wants to start a new program in computer graphics?

Comments:

APPENDIX B

Universities Contacted

1) Marycrest College
Department of Art
Davenport, Iowa 52804
ATTN: Alan Garfield

2) Academy of Art College
Graphic Design/Computer Graphics Dept.
625 Sutter St.
San Francisco, California 94102
Attn: Carl E. Ballay

3) University of California
Graduate School of Architecture and Urban Planning
Las Angeles, California 90024
Attn: Prof. William Mitchell

4) California Institute of the Arts
School of Film & Video
24700 McBean Pkwy
Valencia, California 91355
Attn: Ed Emshwiller

5) West Coast University
440 S.Shatto Pl.
Computer Graphics for Artists and Designers
Los Angeles, California 90020
Attn: Tony Longson

6) Illinois Institute of Technology
Institute of Design
3360 S. State Street
Chicago, Illinois 60616
Attn: Patrick Whitney

7) Northern Illinois University
Art Dept.
DeKalb, Illinois 60155
Attn: Bill Kolomyjec

8) Illinois State University
Arts Computer Lab
Center for the Visual Arts

Normal, Illinois 61761

9) The School of the Art Institute of Chicago
Art and Technology
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10) University of Illinois-Chicago Circle
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11) Montgomery College
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12) Harvard University
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Attn: Dennis White

13) Massachusetts Institute of Technology
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14) Center for Creative Studies
Dept. of Graphic Communication
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Attn: Phil Little

15) University of Missouri-Columbia
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16) School of Visual Arts
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Attn: Darcy Gerbarg
Attn: Timothy Binkley

17) Syracuse University
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Attn: Edward Zajec

18) Pratt Institute
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Attn: Susan Bickford

19) New York Institute of Technology
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20) University of Oregon
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21) Sheridan College
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22) University of South Dakota
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23) Bowling Green State University
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24) California State University-Dominguez Hills
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25) Massachusetts College of Art
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26) Philadelphia Collage of the Arts
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27) Rhode Island School of Design
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28) Carnegie-Mellon University
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28) Rochester Institute of Technology
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30) Middlesex Polytechnic
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31) Queensland College of Art
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32) Swinburn Institute of Technology
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